INTERNATIONAL PARTNERSHIP FOR
HYDROGEN AND FUEL CELLS IN THE ECONOMY

Database of Job Roles and Skills Needs: References and Report Summaries

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1 Needs assessments that provide information on job roles and skills that have been included in the database of job roles and skills

Country	**Australia** (Federal)	**Publication Date**	October 2022
Title	Developing Australia's Hydrogen Workforce		
Goal		**Commissioned by**	**Done by**
The goal of the study was to provide a foundation for the development of a skilled and capable workforce to support a safe and effective hydrogen economy in Australia in 2030. The specific goals of the study were: 1. To Identify the type and number job roles needed to support the desired hydrogen activities across the supply chain 2. To determine the hydrogen-specific capabilities (skills and knowledge) these job roles will require to undertake hydrogen-related activities safely and effectively, including whether the job will fundamentally change in scope or only be augmented to undertaken hydrogen tasks. 3. To establish whether the hydrogen specific capabilities needed by the identified job roles are already catered for within the education and training system, or whether training gaps exist that must be filled to support a pipeline of current and future workers for the industry.		Federal Department of Employment and Workplace Relations	PwC
Scope/focus area			
The study focused only on six key supply chain areas in the value chain: • hydrogen production, • hydrogen transportation & distribution, • hydrogen storage, • hydrogen blending into gas networks, • hydrogen as a transport fuel, • hydrogen as an export fuel. Six occupational clusters were considered: • Engineers, Technicians and Tradespersons, • Logistics, • Management, • Safety and Quality Control, • Specialists			

Methodology
The study combined literature review, job board and professional networking site review, stakeholder engagements and stakeholder validation. The general methodology can be summarised as follows: 1. Using consultation and desktop research, the job roles in six occupational clusters that will be required to support and enable the six areas of the hydrogen supply chain were identified and mapped onto the supply chain areas. Job roles were defined at Level 1 or Level 2 of the Australian and New Zealand Standard Classification of Occupations (ANZSCO) taxonomy. The level of augmentation required to undertake hydrogen related activities was determined for each job role. A detailed augmentation analysis for each job role in each of the occupational clusters was developed. The augmentation analysis also noted where there were not any ANZSCO codes for any particular job role and where codes for similar roles were assigned. 2. Detailed consultations were undertaken to identify the hydrogen-specific capabilities (skills and knowledge) required by the job roles to safely and effectively engage in hydrogen activities. 26 hydrogen specific capabilities were identified. 3. Consultation was used to map the identified job roles to the hydrogen-specific capabilities in the form a capability matrix This supported an understanding of which job roles require each skill/knowledge requirement, including whether it is a core or specialist capability of the job role. 4. The hydrogen-specific capabilities were mapped against existing training pathways in Australia to understand existing hydrogen training pathways and potential training gaps that need to be filled. 5. Quantitative research and analysis was used to develop a model that identifies the number of jobs in each occupational cluster required by 2030 under three hydrogen production scenarios 6. The various inputs were collated together to develop a view of what the hydrogen workforce in Australia will look like in 2030 and what is currently available in the education and training system to support and enable this workforce.
Key outcomes/findings
No new job roles are required. 46 existing job roles will be augmented to undertake hydrogen activities. (Details of the augmentation have been provided in the occupational cluster augmentation analysis which is included in the IPHE job roles and skills database.) Some job roles will augment more than others, but most will only experience low-moderate changes to day-to-day tasks and skill needs. Logistics workers and Technicians and Tradespersons are likely to experience the greatest amount of job role augmentation. Incremental hydrogen-specific upskilling will complement workers' existing base of education and training. The estimated demand for job roles will be greatest for Engineers and Technicians and Tradespersons, under a medium demand scenario. There are limited existing hydrogen education and training pathways. For example, there are only six dedicated hydrogen training products in the vocational education and training (VET) system. A whole-of-system education and training approach is required to support the required pipeline of workers for the desired hydrogen economy.

Country	Canada	Publication Date	July 2022
Title	Assessing the Workforce Required to Advance Canada's Hydrogen Economy **and the accompanying** Hydrogen Workforce Assessment Tool		
Goal		**Commissioned by**	**Done by**
The primary objective of the study was to establish a common, foundational understanding of the core occupations[1] needed by low carbon hydrogen supply and demand value chains in order to advance Canada's hydrogen economy. The accompanying Hydrogen Workforce Assessment Tool was created to support Canada's HUB approach[2] by presenting detailed assessments of the occupations per value chain component. The intent was to enable the HUBs to determine the specific talent needs, opportunities and risks for those value chain components of relevance to them.		The Transition Accelerator (a pan-Canadian non-governmental organization supporting Canada's clean energy transition)	Creative Links International Inc.
Scope/focus area			
The study covered the following value chain stages: • Production (supply) • Storage, upgrading and transportation (distribution) • Fueling stations (distribution) • Heat & power generation (demand) • Transportation (demand) • Manufacturing for hydrogen (enabling). Analysis of value chain stages was done at a technology specific level for • Production: Proton Exchange Membrane (PEM) Electrolysis; steam methane reforming (SMR) and autothermal reforming (ATR), carbon capture and storage (CCS); • Storage, Upgrading and Transportation: underground storage, pipeline transmission, truck distribution of compressed gas and cryogenic liquid hydrogen, ammonia as a chemical carrier In addition to technical core occupations, the study included core occupations employed across all value chains that are focused on creating the ecosystem required for the development of the hydrogen economy.			

[1] "Core occupations are defined as those that are key to the industry's ability to sustain operations. They are often hired in significant numbers but can also represent occupations that have a significant impact on the business or industry's ability to succeed."

[2] The HUB approach "focuses on scaling a region's hydrogen supply and demand assets."

Methodology

The study combined previous experience in energy labor market analysis, literature- and webinar review, job board reviews, stakeholder engagements and expert validation.

The methodology can be summarised as follows:

1. Core occupations across the defined value chain components were identified.
2. Skill and knowledge considerations were identified based on an assessment of the design, operations & maintenance implications of specific hydrogen properties in comparison with other fuel types.
3. Using the above information, it was determined which of the job roles were crucial to the development of the hydrogen economy (not necessarily in numbers but also in unique skills that could cause bottlenecks).
4. For these roles, talent opportunities and risks were identified. Talent opportunities were assessed on existing experience and transferability of skills. Talent risks covered matters such as an existing shortage of skills and the similarity of jobs required for the different stages of projects - this competition paired with existing resource demand could lead to shortages of suitable labour.
5. An assessment was also made of the nature of the workforce transition and how to enable this to be a just workforce transition and development of the hydrogen economy.

Key outcomes/findings

Hydrogen Workforce Assessment Tool provides a summary of workforce requirements and potential talent opportunities and risks for 236 core occupations (which is included in the IPHE job role database). The assessment report includes a framework for- and recommended next steps for accelerating workforce transitions and development for the hydrogen economy.

The readiness of the required hydrogen workforce can be enhanced by, among others:

- Developing and implementing short-term training practices (e.g. micro-credentials, training bootcamps, work integrated instruction) that expand to build on existing expertise
- Promoting low-carbon hydrogen as an industry of choice to attract talent interested in being part of climate solutions
- Expanding collaborations established to accelerate hydrogen technology and value chains (e.g. pilot and demonstration projects) to include addressing workforce transition and development requirements.

Some of the risks identified include

- Labour supply constraints already exist for some of hydrogen's core occupations (Examples include plant operators with higher class power engineering certificates, instrumentation technicians, truck drivers with appropriate licences, inspectors.)
- Talents pools available for hire lack diversity
- Training programs need to be developed for new occupations and skillsets that are emerging as the hydrogen economy is developing. (Examples include electrochemical engineers, fuel cell technicians, business-, commercial development- and sustainability specialists.)
- A lack of industry-endorsed standards for hydrogen skills and knowledge is holding back the development of relevant training including for emerging occupations.
- Lack of understanding of the hydrogen economy and the potential career and workforce transition opportunities creates a level of uncertainty that causes stakeholders from investing in workforce development and those making career decisions from pursuing relevant training.

Country	France (Whitepaper)	Publication Date	April 2021 (French) / January 2022 (English)
Title	Skills and professions of the hydrogen sector: Planning ahead to successfully develop an industry of strategic importance		
Goal		**Commissioned by**	**Done by**
The aims of the study were as follows: 1. To record and list the skills and professions needed to develop the hydrogen sector in France 2. To identify the related requirements and potential challenges 3. To analyse the role of training in light of these challenges 4. To highlight the areas to which special attention must be paid to ensure the long-term health of the sector.		France Hydrogène (a multi-stakeholder association for the advancement of the French hydrogen sector)	Infinergia

Scope/focus area

The study covered the following value chain stages/applications:

- Production (Electrolyser, purification system (H_2, H_2O), biomass-based production system, hydrocarbon-based production system, H_2 co-production)
- Storage, compression and transport (trailers, trucks, gas networks)
- Injection into the gas distribution network
- Hydrogen for transport: light road vehicles (cars, LCVs, commercial vehicles), heavy road vehicles (buses, coaches, trucks etc.), H_2 planes, H_2 trains, sea and river transportation (boats, shuttle boats, barges, ships etc.)
- Refuelling stations
- Heat pumps (stack & balance of plant)
- Stationary fuel cells (boilers, emergency generators)
- Industrial processes using H_2

Methodology

The study combined literature review and engagement with industrial actors.

The methodological approach can be summarised as follows:

1. Literature review: 11 publications were used to create summary of industry needs. The following filters were used to compare the documents: profession, skill, activity, level of education, certification/qualification.
2. The results obtained through literature review were supplemented by responses from 15 hydrogen industry stakeholders.
3. This resulted in an inventory of 84 professions with associated skills. The following characteristics were recorded for each of the professions:
   Level of education: Level of academic study attained
   Certifications/qualifications: Prerequisites of a profession
   Technical skills and non-technical skills: combinations of understanding (knowledge) and know-how (practical experience)
   H_2 specific skills: Level of understanding of the H_2 field needed by a profession
   Activities: A product's place in the manufacturing process (design, production, installation and

operational deployment, operation and maintenance)
Candidate shortages: Scarcity of candidates and associated recruitment issues
Applications/components (value chain stage): application using hydrogen

4. The inventory was analysed to identify, among others, the types of skills required to perform core business activities, which skills are in high demand, the level of education required at different stages of project development and the attendant degree of hydrogen specific knowledge required, the skills required for different activities and value chain stages/applications, hard-to-fill positions and the number and diversity of professions for different activities and value chain stages/applications.
5. Further work was done to identify challenges associated with the skills, the adequacy of current training provision to meet the needs of the hydrogen sector, which professions require accreditations and to identify focus areas for interventions to ensure the long-term health of the hydrogen sector in France.

Key outcomes/findings

An inventory of 84 hydrogen value chain professions and skills was developed. The inventory maps the various professions in terms of level of education, level of hydrogen understanding, activities, value chain stages/applications involved in, as well as the relevant technical and non-technical skills (e.g. proficiency in English, team management) (The information in the inventory has been added to the IPHE job role database.)

Some of the key findings of the study include:

- The hydrogen sector draws on existing professions. The various professions require different levels of specialist expertise in hydrogen: 27 professions (32%) require in-depth expertise, 41 occupations (49%) need a basic understanding, 16 (19%) occupations require no hydrogen-specific knowledge at all.
- 17 of the professions were identified as being in high demand i.e. where there is currently a shortage of suitable candidates as they are in demand across a number of industry sectors.
- During the current phase of large-scale expansion of the hydrogen sector in France, the focus is on design of equipment and facilities. There is a substantial demand for graduate engineers with expertise in technical aspects of the hydrogen sector and candidates who have studied to at least an MSc or equivalent level.
- As the industry expands and there is a need for more manufacturing and construction of hydrogen distribution facilities, as well as operations and maintenance, there will be a demand for technicians and operators.
- For engineers, technicians and operators, hydrogen specific skills required by their positions is provided through in-house training.
- Formal hydrogen-specific tertiary-level courses are limited. Hence some industry actors are actively developing training modules in partnership with local institutional partners and educational establishments.
- An immediate focus on expanding formal training provision needs is required to counter the risk of a shortage of skills and expertise.
- The hydrogen industry experiences challenges in attracting talent. Interventions to resolve this challenge need to be implemented in short order.

Country	France (DEF'HY)	Publication Date	July 2023
Title	**Developing employment and training for the hydrogen sector. Anticipating needs and preventing challenges in a rapidly growing sector** **(In French. Original title: Développer l'emploi et les formations pour la filière hydrogène** **Anticiper les besoins et prévenir les difficultés d'une filière en fort développement)**		

Goal	Commissioned by	Done by
The aims of the study were as follows: • to provide a more detailed analysis of hydrogen specific skills for value chains stages considered an immediate priority • to determine that potential challenges for recruitment considering the dynamics of the employment market and to identify transition pathways from other sectors (particularly sectors in decline) to those hydrogen stages of the value chain that are currently recruiting • to develop an inventory of current training associated with the professions and recommendations to accelerate the development and visibility of these training offers.	France Hydrogène (a multi-stakeholder association for the advancement of the French hydrogen sector)	DEF'HY project consortium: a multi-party consortium of France Hydrogène and key employment and training organisations in France.

Scope/focus area

The study focused on 77 professions covered in the France Whitepaper (above), but specifically focused on three elements considered immediate priority, namely

- Production (electrolyser)
- Manufacturing (electrolyser)
- Refueling stations.

The study considered the specific role played by the professions in the value chain:

- Design, engineering, research and industrial development
- Operations (installation, operation and maintenance)
- Quality, environment, compliance and risk management
- Support functions.

The study considered two common hydrogen specific skills focus areas for the professions, namely:

- Safety, regulations and standards (transversal skills) and
- Hydrogen systems – electrolyser, fuel cell and refuelling station (specialised skills)

Methodology

The study built on the experience of the training and recruitment consortium members, and gathered data via industry stakeholder engagement and analysis of job boards and training databases.

The approach taken was as follows:

1. A qualitative survey of France Hydrogène members and employers in the sector on their recruitment- and HR-related needs for their development
2. Mapping of professions in the hydrogen sector against the codes of the French Operational Directory of Trades and Jobs (ROME). ROME (Répertoire Opérationnel des Métiers et des Emplois) is used in analyses carried out by the France's national employment agency (Pôle employ) and by the network of regional vocational training and employment support organisations (the Carif-Oref Network (RCO)
3. Identification and analysis of job postings through the search engines and semantic analysis algorithms of the Adecco Analytics tool.
4. Exploring the RCO databases to conduct an assessment and develop an inventory of available training offerings
5. Engagement with companies and training organisations from the France Hydrogène network (via interviews and collaborative workshops) and drawing on the expertise of AFPA (the French National Agency for Adult Vocational Training) and experience of the European Institute of Innovation and Technology (EIT) InnoEnergy ecosystem to enrich and validate the skills matrices, complete the training inventory and develop recommendations.

Key outcomes/findings

Key outputs of the study included:

- A common framework for the description of hydrogen related skills across the professions. The intent of this framework is to align training and recruitment and thus to enable the sector to have access to the specific skills needed for its development.
  The framework was presented as two skills matrices summarising the common skills for the 77 professions relevant to the focus areas. One skills matrix was done for safety, regulations and standards (transversal skills) and the another for hydrogen systems – electrolyser, fuel cell and refuelling station (specialised skills). These mapped four skills levels (awareness of risk to ability to prevent and control or supervise operations; basic general knowledge to ability to design, respectively) and listed the specific skills required. The detailed information in the skills required by the different professions has been included in the IPHE job role database.
- A detailed analysis of supply and demand imbalances for the 77 professions and the reasons for those, leading to 35 detailed occupational case studies of supply and demand imbalances at a regional level and the development of career transition pathways from declining sectors to those components of the hydrogen sector experiencing recruitment growth. This analysis was enabled, among others, by the mapping of the 77 professions in the hydrogen sector against the ROME codes.
- An inventory and assessment of the training programs linked to occupations in the hydrogen sector, accompanied by recommendations to accelerate their development and enhance their visibility. 216 training offerings were identified. Of these only 35% were certified in line with the developing nature of the sector. Training providers initially focused on 'enhancing' existing programs (primarily at the Bachelor's level) and developing awareness modules. In general, industry players were either not aware of the training available or considered it inadequate. Companies, particularly the larger ones, have developed internal training to address their needs. The need for the training of trainers to enable the rapid scaling of appropriate hydrogen-specific training was highlighted.

Some additional insights from the study, include:

- No new professions would be required; just augmentation to include hydrogen specific knowledge and experience.
- For each of the focus areas (i.e. production via electrolysis, electrolyser manufacturing, refueling stations), an analysis of the number of employees in different types of professions in each of the stages of development of projects (i.e. planning, design and engineering, construction, commissioning, operations and maintenance) showed the same general trend of a shift in employment from the majority of roles being engineering during the design phase to the majority of roles being technicians during the operation and maintenance phases. For France, in aggregate across the three focus areas, this would entail a shift of the order of 80% engineering roles / 20% technicians during the initial innovation and development stage (2023-2025), to 60% engineering / 40% technicians during project

establishment period (2026-2028) and finally to 20% engineering/80% technicians once production, manufacturing and the refueling network are all well established and operational (2028 – 2030).

- Hydrogen-related skills were found to be similar and thus transferable across project phases and across the three focus areas, so that the initial design phases for the systems and the refueling station network (which would develop most rapidly) would to some extent build the foundation in terms of skilled professionals and establishing the training ecosystem that could then adapt to the evolving needs of the sector.

Country	**India**	**Publication Date**	March 2024
Title	**Skill Gap Assessment Across Green Hydrogen Sector in India**		
Goal		**Commissioned by**	**Done by**
The goal of the study was to identify the qualifications and competencies to meet industry demand for skilled personnel in the renewable hydrogen sector. The broad objectives of the study were: 1. To support India's National Green Hydrogen Mission targets on skilling and job-creation 2. To map the existing and potential new job roles across the green hydrogen value chain. 3. To identify skill gaps and outline opportunities to develop and implement skill interventions in the short term, medium and long term (to 2030).		USAID South Asia Regional Energy Partnership (SAREP) / Indian Skill Council for Green Jobs (SCGJ). Published by the Ministry of Skills Development and Entrepreneurship.	USAID and SAREP Team
Scope/focus area			
The study focuses on two main value chain areas: • hydrogen production • electrolyser manufacturing These were broken down into three phrases: • pre-construction activities • construction activities • post-construction activities. The study also considered skills needs for other value chain stages with a specific focus on skills needs associated with short, medium and long term R&D needs of India, production, storage and end-use as well as the skills implications of the transformation to renewable hydrogen in end-use (fertiliser, chemicals, refineries, iron and steel, cement, shipping).			
Methodology			
The study combined literature review of international skills needs and workforce assessment and skills development initiatives, case studies of existing hydrogen industries in India and industry engagements across the value chain. The approach taken was as follows: 1. An assessment was undertaken of current Indian hydrogen market. This considered current projects (operational, under construction and those at final investment decision (FID) and expected future			

projects to 2030. The analysis also considered current and future R&D to get an indication of technology developments and technology transitions that and implications of these for skills requirements.

2. Based on a mapping of companies currently producing or consuming hydrogen, industry engagements were done to understand the current status with regards to job roles (type, number) and the skills requirements for the adoption of renewable hydrogen in these processes (refinery and fertiliser, chemicals and iron and steel, shipping and cement).
3. A review of literature was done to obtain insights on the nature of the hydrogen economies and hence job roles, skills requirements, and skills initiatives of other countries. The literature review covered Australia, the USA, Germany, Japan, and Saudi Arabia. In addition, an assessment of the relative demand for different kinds of job roles in these countries was done by analysing job posting on job search platforms prevalent in the specific countries. Key learnings were extracted to assist with identifying the key job roles and associated skills and to help identify interventions to strengthen the hydrogen skilling ecosystem in India.
4. For the skills gap analysis for India, the specific job roles for hydrogen production and electrolyser manufacturing were split out into those required for different stages (i.e. pre-construction, construction and post-construction) which were then further divided into activities / domains (e.g. planning and design, financing and compliance, installation and commissioning, equipment testing and certifiers, safety, operations, maintenance, support activities etc.). The specific roles and number of positions were then mapped at each skills level (L3 – L8 based on the occupational standards defined by the SCGJ) for each stage and each activity for 1 GW (1000 MW) facilities.
5. Estimates of total number of jobs (recurring and non-recurring) by 2030 were generated for a number of scenarios differing in assumptions on the number of facilities at different scales (10 MW, 100 MW, 1000 MW). Using the detailed job role information (from 4. above), an estimate of number of role per skills level in different activities/domains were obtained. Estimates for annual new job opportunities and annual demand for upskilling and reskilling to 2030 were also determined.
6. To identify skills gaps, an assessment was done of the sectors in which each job role could potentially already be found that best matches the requirements of the hydrogen roles. The skill gaps that would need to be filled in order to meet hydrogen skills requirements were then identified. These were classified as low, medium and high based on the changes in tasks/responsibilities and the need for up/reskilling to obtain new expertise. The relevant details were provided per job role.
7. In order to identify priority job roles for skilling for the hydrogen sector in India, the jobs identified were rated between 1 and 3 according to: availability, criticality and demand. This was then used to identify the five priority jobs and suggested curricula were outlined to assist with the upskilling of the workforce in these priority roles.

Key outcomes/findings

The study provided an inventory of job 54 roles for hydrogen production and electrolyser manufacturing with information on capability/skills required for each job role, existing sources of relevant skills, skills gaps and the degree of augmentation required (high, medium, low). The information in the inventory has been added to the IPHE job role database.)

Five priority job roles for skilling for the hydrogen sector in India identified. These were green hydrogen plant technician (hydrogen production), process engineer (hydrogen production); electrolyser technology specialist (electrolyser assembly and manufacturing), operations & maintenance head (hydrogen production), integration engineer/ solution architect (hydrogen production). The study provided outline level curricula to assist with the upskilling of the workforce in these priority roles. The study also made a number of actionable recommendations for skills and workforce development in India with timeframes and responsibility assigned to relevant parties (government, agencies, industry, institutions) for implementation.

The study made a number of notable methodological contributions, including:

- The level of detail to which job roles are outlined – both in terms of project stages and project activities – and the provision of information on number of each job roles (including support roles) at a unit level (for 1 GW facilities).

- Mapping of the skills implications of the transformation to renewable hydrogen in end-use (fertiliser, chemicals, refineries, iron and steel, cement, shipping) showing current job roles (including number of roles and new / alternative roles when introducing renewable hydrogen.
- Considering the skills implications based on technology readiness level in India and short, medium and long term R&D needs
- Scaling quantitative projections of job numbers based on unit level job numbers and job roles (as opposed to using input /output multipliers) and being able to articulate this at a skill level per activity (e.g. planning, design, operation and maintenance, safety etc.)

Country	Namibia	Publication Date	August 2023
Title	Enhancing Employability: Skills Needs and Gap Analysis in Namibia's PtX Sector and Recommendations for a Skills Development Programme **The report has number of annexures that are published separately.**		
Goal		**Commissioned by**	**Done by**
The study was undertaken to provide a foundation for designing effective strategies to enhance the employability of the Namibian workforce and support the development of a skilled workforce in the PtX economy. To this end, the goals of the study were as follows: 1. To explore the skills needs gaps in Namibia's PtX sector and propose solutions to improve the employability of Namibians within this sector 2. To bridge gaps between the current skills in the population and future skills requirements by considering: curriculum development, technical vocational training programs and capacity building initiatives that promote inclusivity, and equitable access to opportunity 3. To provide actionable insights that can assist with policy formulation, investment decisions and educational development.		International PtX Hub implemented by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry for Economic Affairs and Climate Action (BMWK) and funded by the International Climate Initiative (Internationale Klimaschutzinitiative – IKI)	RENAC – the renewables academy in collaboration with the Namibia University of Science and Technology (NUST)
Scope/focus area			
The study covers the renewable hydrogen and PtX sectors. It covers the following value chain stages in detail: • renewable hydrogen production (PV, wind, battery storage, electrolysis) • hydrogen compression, storage and transportation • ammonia production • hydrogen refuelling stations and fuel cell heavy duty vehicles For each of these, the study considers the following project phases: • planning and design; transportation • construction and installation • operation and maintenance. The study also covers "indirect" jobs in the following areas at a lower level of detail: • infrastructure (ports, desalination plants, power transmission lines, water supply network, roads) • the enabling environment (regulatory, policy, societal, environmental, education and training).			
Methodology			
The study included: stakeholder mapping, a skills needs assessment and an education gap analysis. The approach taken for each of these elements was as follows: 1. Stakeholder mapping: The stakeholders identified for this study were private sector PtX and hydrogen companies for the skills needs assessment and educational institutions for the education gap analysis. Interviews were also done with representatives of relevant government ministries.			

2. Skills needs assessment: Interviews were done with Namibia's PtX private sector companies. As many of the private sector companies are at early planning stages and do not as yet have complete information on their job roles and skills needs, this information was complemented by information on skills requirements in international literature.
3. Gap analysis: Interviews with education institutions were done to compare the existing educational ecosystem in Namibia in relation to the identified skills needs. Differences between the current skill levels and the desired skill requirements for the PtX industry were determined in order to identify the pathways where skills development interventions are most urgently needed. These findings formed the basis for a proposed skills development programme.

Key outcomes/findings

The study outlined 48 job roles for all the value chain stages and project phases within its scope and provided a general description of the skills requirements for those working in these value chain stages. The 48 job roles and detailed descriptions have been added to the IPHE job role database.

It is notable that:

- The renewable energy related roles (PV, wind, battery storage) were included in the production stage (along with electrolysis) hence skills needs were expressed at a more general level than in studies where the production of hydrogen via electrolysis is treated separately.
- The study included some consideration of indirect and induced jobs and associated skills needs, i.e. brief outlines of job roles and skills in infrastructure, the enabling environment and other services were also provided.

Other notable contributions and outputs from the study include:

- Provision of the detailed interview protocols for industry and education institution stakeholders (included as annexures).
- For each of the relevant job roles under the various occupational groupings, a status assessment of relevant current qualifications offered by TVET and higher education institution and proposals for potential training modules to be added to the existing training programmes to address any hydrogen and PtX-related skills gaps.
- An analysis of barriers to provision of industry relevant training, one of which is the challenge to obtain practical experience (in a training setting or workplace) due to the nascent nature of the hydrogen / PtX industry in Namibia.
- Recommendations for 14 key action items in the short (0-3 years), medium (4-10 years) and long-term (11-30 years) to develop hydrogen and PtX related skills to enable the development of the hydrogen and PtX economy in Namibia.

Country	South Africa	Publication Date	April 2024
Title	Identification of Skills Needed for the Hydrogen Economy		
Goal		**Commissioned by**	**Done by**
The objective of the study was to determine the skills that will be required for the renewable hydrogen value chain in South Africa in order to assist government and non-governmental stakeholders to proactively develop the appropriately skills workforce for the establishment, growth and sustainability of the emerging renewable hydrogen economy in South Africa. To this end, the study aimed to answer the following questions: 1. What are the current and future demands for skills required for the hydrogen economy? 2. What is the available supply of skills for the development of the hydrogen economy? 3. What skills imbalances are envisaged for the development of the hydrogen economy (including occupational shortages and surpluses, skills gaps, and mismatches)? What are the reasons for these imbalances? How can they be addressed? 4. Are the qualifications, programmes, and curricula offered at South African HEIs and TVET colleges appropriate for the development of the hydrogen economy? If not, how can these be changed and/or improved upon? 5. Are there sufficient opportunities for workplace-based learning (WBL) for hydrogen economy–related skills in South Africa as well as internationally? If not, how can this problem be addressed?		Department of Higher Education and Training (DHET)	Council for Scientific and Industrial Research (CSIR)
Scope/focus area			
The study considered the following value chain stages: • Production: electrolysis, compression (to pressurised gas or liquid), conversion to ammonia and methanol • Storage • Distribution and transportation • End-uses: heating, power generation, transport, industrial processing (oil refineries, steel and iron production, chemical production).			

Methodology

The methodology used in this skills needs assessment was primarily a review of national and international literature, and engagement with industry and post-school education & training (PSET) stakeholders to validate information. Online recruitment platforms were also used to determine the availability and demand for occupations in the South African context.

The approach taken was as follows:

1. The literature review was used to identify the required occupations across the selected value chain stages. Elementary occupations (e.g. cleaner, construction labourer etc.) were also considered.
2. The identified occupations were then assigned occupation codes, where possible, using the South African system for the classification of occupations – the Organising Framework for Occupations (OFO). The occupations were clustered as was done in the study for Australia (see above) to enable comparison rather than using the OFO occupational categories.
3. The occupations identified were then expanded upon to cover the required qualifications (or proposed qualification where not currently available in South Africa) and an indication provided of whether the occupations are currently present or not present in the South African labour market (based on data gathered from online recruitment platforms).
4. Literature sources were used and further data collection was done to identify the range of hydrogen specific skills that may be required by the different occupations.
5. The hydrogen specific skills for the identified occupations were then mapped in a matrix to identify which occupation would require which hydrogen specific skills when working in a particular value chain stage. A separate matrix was developed for each occupational grouping.
6. An assessment was done of the current provision of training in South Africa for the identified occupations, where there are mismatches between the qualifications required for the hydrogen value chain and those offered by higher education institutions in South Africa, and the augmentation needed in the occupational qualifications, i.e. the specific hydrogen capabilities that need to be embedded in each qualification to prepare graduates for the hydrogen economy.

Key outcomes/findings

The study identified 138 occupations across the value chain stages within its scope.
The 138 job roles and associated descriptions have been added to the IPHE job role database.

The study produced a number of matrices to summarise information on occupations and hydrogen specific skills:

- One set of matrices covered the occupation, its relevant OFO code (where available), qualifications required (and whether these are offered in South Africa or not) and the relevant value chain stages in which the occupation is needed. An indication was also given on whether the occupation is available in the South African labour market. (Of note is 77 of the 138 occupations were not provided for in the OFO.)
- Another set of matrices mapped the relevant hydrogen specific capabilities per occupation per value chain stage for the different occupational grouping.

In addition, the study provided a number of training related assessments including:

- a mapping of the specific hydrogen related capabilities per university level qualification required for the various occupations, and whether these were being provided by South African training institutions or not. (Of note is that approximately a third of the qualifications identified for the 138 occupations were not yet offered at South African universities).
- a mapping of relevant vocational qualifications and how these would need to be augmented to enable them to be adapted for hydrogen specific roles

The study highlighted some of the challenges for skills development given the nascent nature of the sector in South Africa. These include the need for industry-endorsed training and training standards, the need for

training of lecturers and trainers and the challenge to obtain practical experience including through workplace-based learning (WBL) to complete qualifications. It also highlighted that hydrogen related capabilities may well be needed before curricula could be augmented. Hence, the study made recommendations, including the following:

- Development of continuous professional development programs that incorporate hydrogen capabilities
- Promotion of learner and trainer mobility to other countries with more well-established hydrogen economies to enable hydrogen-specific work-based learning and knowledge transfer.

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